THE 1957 DROUGHT IN THE EASTERN UNITED STATES

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ABSTRACT

Various aspects of the Eastern United States drought of 1957 are discussed and some of the pertinent data are tabulated and summarized. These include amount of the summer rainfall, a derived and experimental measure of "moisture adequacy," and the 5-month percentage of long-term mean precipitation—by climatological divisions insofar as possible.

Some of the unusual and record-breaking aspects of the weather during the spring and summer are listed and monthly precipitation reports from 113 selected points from Virginia to Maine are tabulated. In addition actual measurements of soil moisture are tabulated for a number of locations.

The worst of the moisture deficiency occurred in the coastal strip from inner Cape Cod to the Virginia Capes, a conclusion borne out by summaries of the streamflow and ground-water measurements of the Geological Survey as well as by the crop condition reports of the Agricultural Marketing Service.

1. INTRODUCTION

After Samuel Johnson issued (in 1755) his pioneer English dictionary a lady asked him why he had incorrectly defined "pastern" as "the knee of a horse." Dr. Johnson replied, "Ignorance, Madam, pure ignorance."

This story is an appropriate preface to an article on drought, because ignorance on this subject is not only pure but widespread. Of course, a farmer surveying his parched crops and withered pastures does not need a dictionary or scientific treatise to know that a water shortage exists. The trouble with defining and describing this shortage is the fact that drought involves many factors, which are inadequately measured, incompletely understood, and highly variable as regards location, kind of crop, type of soil, time of year, etc.

In general, there are two climatological approaches to a discussion of drought. It is easier to take the "high road" and treat the subject in terms of rainfall deficiencies. This approach is justified insofar as there exists a useful relationship between rainfall and crop response; but simply defining drought as a lack of precipitation does not even begin to tell the whole story. For example, a month with frequent light rains resulting in low total rainfall may look like a dry month, but actually may be more favorable to plant growth than a month with a high total, the result of a heavy downpour or two.

As a gross measure of drought, however, deficient rainfall is usable; crop damage in the Northeast is certainly indicated by the map of total precipitation for the summer (June-August) 1957 (fig. 1). This map shows in general, that only about 4 to 8 inches of rainfall occurred during the summer over southern New England, southern New York, New Jersey, most of Pennsylvania, Delaware, Maryland, and West Virginia. Since the normal June-August rainfall for these areas ranges between approximately 10 inches along the Massachusetts coast and 14 inches in the West Virginia mountains, it is apparent that the something known as drought must have affected certain areas and certain crops for certain periods during the summer. The moral is that the "high road" to drought, though broad and easy to follow, does not lead very far by itself.

2. MOISTURE ADEQUACY

To take the "low road" is to follow the rainfall into the ground and try to arrive at an evaluation of drought through the complex interrelationships that were mentioned above. Several methods have been devised for

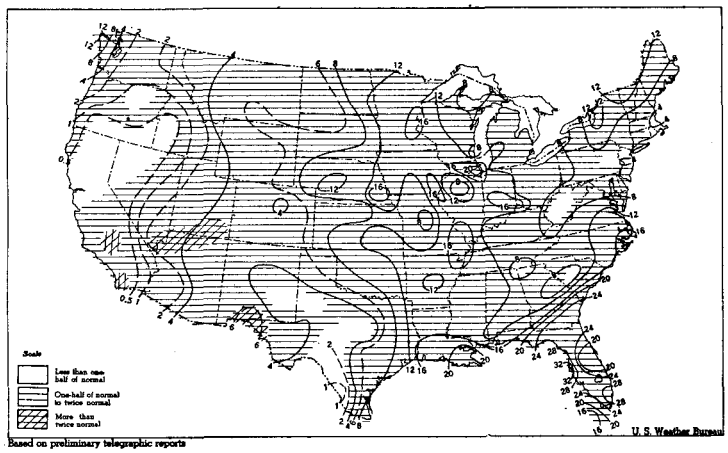

FIGURE 1.—Total precipitation, inches, summer (June–August) 1957. (From *Weekly Weather and Crop Bulletin, National Summary*, vol. XLIV, No. 36, Sept. 9, 1957.)

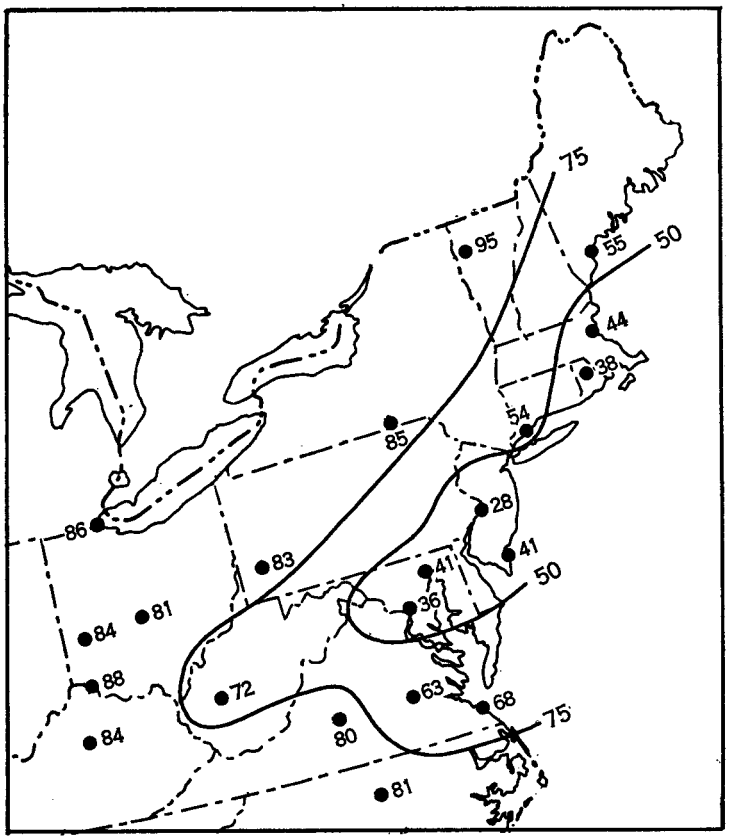

FIGURE 2.—Percentage of moisture adequacy, June 17–August 18, 1957.

accomplishing this objective, all involving assumptions and simplifications. One of these methods makes use of the idea of "moisture adequacy."

This idea was developed from the concept of potential evapotranspiration [1], which is defined as the amount of water given up to the atmosphere from a surface completely covered with vegetation that at no time is limited by soil moisture. Potential evapotranspiration can be approximated for any place for any given period of time from climatological data. It represents the estimated maximum moisture requirement of the vegetation at that place and time. This estimated moisture need can be compared with the actual moisture supply (rainfall plus available soil moisture), to obtain a second estimate, here called "moisture adequacy." This is simply the percent sufficiency of the actual rainfall and soil moisture toward meeting the estimated maximum moisture need of the growing plants during the particular period.

Figure 2 presents the moisture adequacy (in percent) for a number of locations in the Northeastern States for the 9-week period, June 17 to August 18. This period was selected as being, on the basis of reported rainfall deficiencies and crop conditions, generally the worst part of the drought over the area. The figures shown on the map were calculated on a weekly basis and then summarized, from (a) the actual moisture supply (rainfall plus available soil moisture used during the period), which is the estimated actual use, divided by (b) the potential evapotranspiration, or the estimated maximum requirement. For example, at Washington, D. C., quantity (b) during the June 17–August 18 period was 13.10 inches; but rainfall of only 2.60 inches, and soil moisture withdrawal of 2.08 inches, gave quantity (a) the value of 4.68 inches. In other words, the moisture adequacy of this supply of 4.68 inches was rated as only 36 percent of the 13.10 inches that would give lush vegetative growth.

The above explanation, if not unduly confusing, should make two things clear. First, this notion of moisture adequacy is proposed experimentally, in an attempt to relate the weather factors usually but imprecisely associated with drought more closely to the actual moisture conditions experienced by the growing vegetation. Because of the assumptions underlying the idea, figure 2 is presented tentatively and should not be taken literally. It seems reasonable, however, to suspect that crop production may be linked with moisture adequacy, when the latter is computed for critical phenological periods, though there has not yet been enough experience with this type of derived climatological information to permit the determination of "critical values" or relationships with other pertinent factors.

The second point is the impossibility of using moisture adequacy values, when plotted and analyzed as in figure 2, to show anything but the general drought pattern. One basic reason for this limitation is the great areal variability of rainfall, especially in the case of small-scale showers and local thunderstorms. Even over so small an area as the District of Columbia and environs, for instance, amounts varied considerably during the 4-month period, April through July 1957. Twenty stations in an area about 20 miles square indicated a mean rainfall of 10.26 inches for the area during the 4 months. (The normal for this period is 14.64 inches at the Washington, D. C. Weather Bureau Office.) Falls Church, Va., located about 7 miles west of the Weather Bureau Office, received only 7.93 inches during the 4 months, whereas Beltsville, Md., about 14 miles northeast of the Weather Bureau Office, received 12.78 inches. Undoubtedly a more dense network of reports would have shown still greater variation. Thus, one of two nearby places may suffer from deficient moisture while the other may enjoy average rainfall. This circumstance, to say nothing of the different water-holding capacities of different soils and the varying water needs of various drops, inevitably makes the approach to the drought problem illustrated by figure 2 very generalized.

3. RAINFALL DEFICIENCIES

Nevertheless, there is reasonably good agreement between the picture presented in figure 2 and the drought situation as described by other indicators. To go into the rainfall distribution in some detail, the Weather Bureau's regular and cooperative observing network provides a fairly dense coverage over the East, except in the mountainous districts. For the mid-June to mid-August period, rainfall measurements from these sources

gave the following general picture. (1) Rainfall was 75 percent of normal or above only in northern New York, extreme northern Vermont and New Hampshire, and the northern half of Maine. (2) The 9-week totals were 50 to 75 percent of normal in the remainder of the above-mentioned States (except southeastern New York), and over the western halves of Pennsylvania, Maryland, and Virginia and all of West Virginia. (3) Less than 50 percent of normal rainfall was received in the coastal belt: southern New England, southeastern New York, New Jersey, Delaware, and the eastern portions of Pennsylvania, Maryland, and Virginia.

This pattern conforms to that of figure 2. In addition, the temperature pattern during the same period was roughly the opposite; that is, above normal temperatures in the interior of the Northeast. It is well known that, other things being equal, growing plants yield to the atmosphere more moisture with increasing temperatures; thus, a given rainfall deficiency may result in drought if accompanied by relatively high temperatures, but not if the temperatures are comparatively low. In sum, the combined temperature-rainfall distribution over the Northeast this past summer was such that the maximum need for moisture was created where deficiencies and losses were the greatest.

Table 1 presents some of the more interesting and unusual aspects of the rainfall deficiencies and other anomalies. From the data and remarks in the table it is apparent that record dryness occurred at many places and times during the spring and summer of 1957. In a number of instances, such as at New York in August, a large portion of the month's rainfall occurred in a single storm. Such heavy downpours are not mentioned solely as oddities. They are rather characteristic of summer dry spells, and tend to "falsify" the comparative statistics, for they usually occur in a matter of hours and the rain runs off so rapidly that vegetation receives comparatively little benefit. If table 1 is considered in the light of figure 2, it is apparent that the Weather Bureau data confirm the moisture adequacy values in their most important respects.

Records of the cooperative observers provide additional details concerning the spring and summer of 1957. A selected sample of the reports of regular Weather Bureau

TABLE 1.—*Some unusual aspects of the spring and summer of 1957*

Place	Time	Precipitation (in.)	Percent of normal	Remarks
Portland, Maine	April	1.91	51	Many forest fires.
	May	2.28	68	5th consecutive month below normal.
	June	2.38	72	1.14 in. of rain on 25th.
	July	1.34	47	No rain greater than 0.31 in. after 5th.
	August	.80	31	Driest August since 1947 and coldest August since 1927.
Boston, Mass.	April	4.46		1.09 in. above normal; 0.35 in., April 10 to May 9.
	May	3.63		0.72 in. above normal; mean temperature 2.1° F. above normal.
	June	1.62	46	Warmest June since 1949.
	July	.64	20	2d driest since 1818; 1952=0.52 in.
	August	1.71	53	Driest June-August on record.
Providence, R. I.	April	4.46		1.09 in. above normal; 4.20 in. in 1st 9 days.
	May	.93	31	3d driest May on record.
	June	.39	12	2d driest June on record.
	July	1.41	46	All ineffective showers of less than 0.50 in.
	August	2.51	69	40% of total fell in 2 hours on 10th.
	May-July		30	4th lowest % of May-July normal on record among 19 Eastern cities investigated. May-July total was 29% of normal at Baltimore, Md., in 1869, at Salisbury, Md., in 1911 and at Columbus, Ohio, in 1930. In 1934 Ft. Worth, Tex., had only 9% of normal during these 3 months and Waco, Tex., only 18% of normal [2].
Bridgeport, Conn.	April	4.06	116	Temperature 3.7° above normal.
	May	2.14	60	Temperature 4.5° above normal; 1.15 in. on 14th.
	June	.40	12	Temperature 4.7° above normal; 2d driest June in 52 yrs.; 0.07 in. in 1949.
	July	2.84	71	Ineffective showers except 0.68 on 13th and 1.41 in. on 29th.
	August	2.92	66	Temperature 1.7° F. below normal; good showers on 4th, 15th, 25th.
New York, N. Y.	April	5.46	170	Temperature 3.0° F. above normal.
	May	1.51	43	4th driest May since 1900.
	June	1.29	35	Temperature 3.4° F. above normal; warmest June since 1943; 2d driest June since 1912, 0.16 in. in 1949.
	July	1.73	41	Only one good rain, 1.12 in. on 13th; 87% of maximum possible sunshine; temperature 1.4° F. above normal.
	August	2.91	67	Only one rain of consequence, 1.99 in. in 24 hrs. on 25-26th. The driest May-August in 120 yrs. of record.
Trenton, N. J.	April	4.93	164	Last 14 days of month averaged 9.6° F. above normal.
	May	1.40	40	Driest May since 1944; 0.71 in. of rain fell in 1 hr. on 20th.
	June	1.47	38	Warmest June (+3.7° F.) since 1943; all rains were ineffective light showers of less than 0.30 in.
	July	1.23	30	6th driest July since 1911; each rain was less than 0.50 in.
	August	1.10	24	2d driest August of record, 0.92 in. in 1869; driest May-August on record.
Atlantic City, N. J.	April	2.28	67	Temperature last 10 days of month averaged 8.6° F. above normal; rain fell on 20 of the 30 days.
	May	.54	18	Driest May since 1911.
	June	2.76	92	No rain of consequence after the 8th.
	July	.31	8	2d driest July since 1874, 0.15 in. in 1894.
	August	3.38	72	Temperature 2.5° F. below normal; good showers on 4th, 15th, 19th, 25-26th; some recovery from drought conditions.
Baltimore, Md.	April	2.46	66	No rain of consequence after the 8th; last 10 days averaged 13.4° F. above normal.
	May	.55	14	Driest May on record.
	June	4.18	119	Temperature 3.7° F. above normal; maximum temperature 90° F. or above 12-19th; no rain of consequence 8-24th.
	July	1.82	46	Only 4 days with rain, 2d lowest number since 1871, 2 days in 1955.
	August	1.09	25	6th driest August since 1871; no rain of consequence until August 25 when 0.80 in. fell.
Washington, D. C.	April	3.24	101	No rain of consequence after 8th; last 13 days averaged 13.2° F. above normal.
	May	3.16	81	2.79 in. on 13-14th; monthly total at Airport=1.40 in.
	June	3.01	88	The only rain of consequence after the 5th was 0.67 in. on 23d.
	July	1.00	24	2d driest July on record, 0.82 in. in 1872.
	August	2.09	47	Only rain of consequence was 1.64 in. on 25th.

TABLE 2.—*Precipitation and its departure from normal*

	April 1957		May 1957		June 1957		July 1957		August 1957		5-month total		
	Precip.	Dept.	Precip.	Dept.	Precip.	Dept.	Precip.	Dept.	Precip.	Dept.	Precip.	Dept.	Percent[1]
VIRGINIA													
Tidewater	2.36	−0.82	2.23	−1.35	3.73	0.14	2.07	−3.24	6.13	0.82	16.52	−4.45	79
Diamond Springs	2.40	−.96	2.02	−1.58	3.73	−.09	1.99	−4.26	6.29	−.29			
Fredericksburg	1.69	−1.46	1.29	−2.31	4.29	1.09	.74	−4.30	6.55	1.70			
East Piedmont	3.29	−.19	2.47	−1.28	3.59	−.10	1.81	−3.23	4.88	.11	16.04	−4.69	77
Farmville	2.68	−.89	2.64	−1.36	4.72	.25	2.16	−2.93	5.33	.61			
Richmond	2.25	−.98	2.75	−.89	3.92	.05	1.80	−3.84	7.46	2.41			
West Piedmont	5.03	1.49	2.61	−1.44	5.06	.79	2.35	−2.64	3.24	−1.52	18.29	−3.32	85
Bedford	4.79	1.36	3.62	−.63	3.78	−.81	1.74	−2.81	2.34	−3.17			
Charlottesville	4.63	.92	3.33	−.70	3.45	−.68	2.32	−3.23	1.35	−3.50			
Danville	4.96	1.56	2.47	−1.88	4.14	.30	.70	−3.90	4.69	.52			
Northern	3.43	.13	2.29	−1.97	3.53	−.16	1.46	−2.73	1.57	−3.33	12.28	−8.06	60
Culpepper	3.40	−.28	3.19	−1.08	2.68	−1.01	.82	−3.95	1.86	−2.62			
Mount Weather	3.10	−.22	3.86	−.40	4.69	1.09	2.58	−.93	1.90	−2.77			
Central Mountain	5.05	2.05	3.02	−.85	5.36	1.38	1.82	−2.53	1.28	−3.33	16.53	−3.28	83
Dale Enterprise	4.88	2.44	3.32	−.67	4.54	.61	1.71	−2.88	.23	−4.16			
Hot Springs	5.13	2.14	2.73	−.92	6.51	2.26	3.05	−1.16	2.11	−2.66			
Southwestern Mountain	5.06	1.84	2.70	−1.24	5.38	1.32	2.99	−2.09	2.12	−2.28	18.25	−2.45	88
Dante	4.31	1.06			5.39	.67	.93	−5.15	2.11	−2.56			
Wytheville	4.31	1.60	2.96	−.66	4.31	1.11	4.82	.57	1.93	−2.19			
MARYLAND													
Southern Eastern Shore	2.52	−.91	1.30	−2.25	3.60	.10	1.65	−2.94	4.58	−.97	13.65	−6.97	66
Crisfield	2.72	−.92	1.47	−2.23	2.29	−1.18	1.57	−3.42	5.97	.90			
Salisbury	3.17	−.16	.69	−3.04	3.34	−.29	1.38	−2.84	2.97	−3.32			
Central Eastern Shore	1.79	−1.65	1.23	−2.86	3.43	−.19	1.14	−3.43	3.17	−2.02	10.76	−10.15	51
Easton, Police Barracks	2.00	−1.59	1.99	−2.04	3.02	−.46	.91	−3.42	3.28	−1.69			
Lower Southern	2.19	−1.36	.78	−3.29	3.78	.26	2.01	−2.86	5.64	.28	14.40	−6.97	67
Owings Ferry Landing	1.85	−1.72	.31	−6.98	2.53	−.82	1.01	−3.01	7.02	1.57			
Solomons	2.87	−.62	1.48	−2.41	4.02	.52	2.09	−3.14	5.63	.52			
Upper Southern	2.72	−.70	1.75	−2.47	3.89	.06	1.85	−2.13	2.66	−2.35	12.87	−7.59	63
Annapolis, USN Academy	1.64	−1.77	.73	−3.26	3.33	−.25	2.01	−1.89	2.05	−2.54			
Washington, D. C., WBO	3.24	.04	3.16	−.75	3.01	−.41	1.00	−3.11	2.09	−2.40			
Northern Eastern Shore	1.99	−1.47	1.68	−2.39	2.87	−.64	1.05	−3.20	2.99	−1.93	10.58	−9.63	52
Millington	1.95	−1.41	2.86	−1.17	2.55	−.81	1.22	−2.70	3.01	−1.93			
Northern Central	3.66	.09	2.61	−1.70	3.64	−.22	1.70	−2.31	1.87	−2.88	13.48	−7.02	66
Aberdeen, Phillips Field	3.75	.55	2.70	−1.31	4.66	1.33	1.18	−2.49	2.86	−.81			
Frederick, WBAS	4.31	.81	2.45	−1.15	2.61	−1.35	1.26	−2.39	1.99	−2.04			
Westminster	4.58	.87	2.38	−1.59	2.54	−1.70	2.21	−1.84	1.72	−3.36			
Appalachian Mountains	4.13	.90	2.04	−1.91	4.15	.27	2.22	−1.35	1.04	−2.89	13.58	−4.98	73
Chewsville, Bridgeport	3.34	.30	1.44	−2.61	4.07	.46	1.41	−2.01	1.30	−2.91			
Picardy	3.75	.80	2.71	−.86	4.86	1.15	3.19	−.27	.93	−3.10			
Allegheny Plateau	4.17	.23	2.56	−1.92	4.00	−.71	3.17	−1.15	1.55	−2.90	15.45	−6.45	71
Sines Deep Creek	4.39	.19	2.37	−2.27	4.30	−.78	3.04	−1.70	1.53	−2.94			
DELAWARE													
Northern	3.84	.27	1.66	−2.56	3.34	−.56	1.58	−2.59	3.14	−2.20	13.56	−7.64	64
Wilmington, WBAS	3.73	.09	2.36	−1.45	3.45	−.57	1.33	−3.16	2.61	−2.67			
Southern	1.78	−1.83	1.60	−2.50	5.03	1.44	1.09	−3.40	2.50	−3.24	12.00	−9.53	56
Bridgeville	1.52	−2.02	1.49	−2.51	8.47	5.05	.71	−3.98	1.67	−3.98			
WEST VIRGINIA													
Northwestern	4.29		3.04		1.13		2.17		.90		14.53		
New Martinsville	4.44	.94	2.78	−.89	3.19	−.92	2.12	−2.37	.98	−2.91	13.51	−6.15	69
Parkersburg, WBO	3.26	.18	4.10	.60	4.42	.24	2.75	−1.41	.73	−3.42	15.26	−3.81	80
North Central	3.99		3.07		3.47		2.44		1.34		14.31		
Clarksburg	3.34	−.03	1.96	−1.72	2.73	−1.54	1.82	−2.26	1.57	−2.91	11.42	−8.46	57
Glenville	3.36	−.40	2.96	−1.16	3.66	−.73	4.85	−.02	.31	−3.92	15.14	−6.23	71
Southwestern	3.06		2.72		3.18		3.11		1.25		13.32		
Charleston, WBAS	2.60	−1.14	2.83	−.95	1.69	−2.24	4.27	−1.18	.66	−3.89	12.05	−9.40	56
Logan	2.54	−1.61	1.56	−2.55	2.17	−2.72	4.59	−.34	2.42	−2.07	13.28	−9.29	59
Central	4.77		2.92		6.08		3.51		2.19		19.47		
Beckley, VA Hospital	2.68	−.80	2.58	−1.05	2.79	−1.62	2.95	−1.43	3.00	−.84	14.00	−5.74	71
Kumbrabow State Forest	7.37	2.21	3.53	−2.59	8.51	2.14	3.95	−3.00	1.96	−3.24	25.32	−4.48	85
Rowlesburg	4.39	.20	2.93	−1.79	5.02	−.35	4.31	−.89	1.13	−3.40	17.78	−6.23	74
Southern	3.08		2.01		4.50		2.30		2.00		13.89		
Gary	4.38	.89	1.77	−2.20	5.07		3.86	−1.07	1.85	−2.26	16.93	−4.64	78
Union	3.47	.58	1.72	−1.48	3.97	−.02	2.00	−1.79	1.74	−2.19	12.90	−4.90	72
Northeastern	3.58		2.02		4.20		2.31		.72		12.83		
Martinsburg	3.81	.70	1.76	−1.63	3.34	−.80	2.17	−1.45	.84	−3.22	11.92	−6.40	65
Petersburg	3.37	.54	2.44	−.85	3.70	.22	1.40	−1.93	.49	−2.74	11.40	−4.76	71
PENNSYLVANIA													
Pocono Mountains	6.54		2.47		4.05		2.58		1.52		17.16		
Pleasant Mount	5.82	1.97	2.93	−1.70			6.27	1.20	2.16	−1.95	17.18	−.48	97
Scranton, WBAS	5.81	2.56	1.44	−2.67	4.01	−.42	2.05	−3.28	1.38	−2.70	14.69	−6.51	69
East Central Mountains	6.59		2.18		4.01		1.34		1.17		15.29		
Allentown, WBAS	6.49	3.10	2.35	−1.62	3.88	−.17	1.05	−3.73	1.39	−3.10	15.16	−5.52	73
Southeastern Piedmont	4.89		1.40		2.85		1.36		1.46		11.96		
Lebanon	5.47	2.01	2.10	−1.91	4.97	.84	1.30	−3.25	.55	−3.71	14.39	−6.02	70
Phoenixville	5.17	1.79	1.13	−3.10	1.85	−2.02	1.26	−3.56	1.67	−3.05	11.08	−9.94	53

See footnote at end of table

TABLE 2.—*Precipitation and its departure from normal*—Continued

	April 1957		May 1957		June 1957		July 1957		August 1957		5-month total		
	Precip.	Dept.	Precip.	Dept.	Precip.	Dept.	Precip.	Dept.	Precip.	Dept.	Precip.	Dept.	Percent[1]
Lower Susquehanna	4.19		1.65		4.20		2.05		1.70		13.79		
Chambersburg	4.08	.91	1.34	−2.46	7.03	3.06	2.24	−1.52	1.33	−2.60	16.02	−2.61	
York	4.55	1.32	1.02	−2.70	2.42	−1.34	1.59	−2.66	2.32	−1.92	11.90	−7.30	
Middle Susquehanna	5.41		1.79		4.71		1.29		1.14		14.34		
Newport	5.15	1.65	1.21	−3.10	5.81	2.20	1.09	−3.42	1.51	−2.72	14.77	−5.39	
Williamsport, WBAS	6.30	2.76	1.93	−2.38	5.74	2.32	1.65	−2.06	1.25	−2.36	16.87	−1.72	
Upper Susquehanna	5.71		2.74		3.85		3.17		2.24		17.71		
Towanda	5.44	2.46	3.39	−.21	2.90	−.76	3.19	−.69	3.17	−.15	18.09	.65	104
Wellsboro	5.47	2.19	2.89	−.98	2.91	−.83	3.06	−.62	2.55	−1.08	16.88	−1.32	93
Central Mountains	5.61		2.07		5.12		2.50		1.89		17.19		
Du Bois	5.20	1.62	2.04	−2.52	4.75	.39	1.54	−3.00	2.91	−.37	16.44	−3.88	81
State College	5.31	1.90	1.64	−2.47	6.94	2.90	2.79	−1.43	2.76	−.49	19.44	.41	102
South Central Mountains	5.20		2.16		5.41		1.98		1.13		15.98		
Altoona, Horseshoe Curve	5.07	1.41	4.04	−.09	7.21	3.03	1.80	−2.20	1.47	−2.04	19.59	.11	101
Everett	4.88	1.79	1.68	−2.02	4.62	−.01	2.02	−1.84	.48	−3.35	13.68	−5.43	72
Southwest Plateau	5.22		2.74		4.14		2.62		1.15		15.87		
Newcastle	5.53	2.44	3.97	.42	4.49	.34	2.93	−1.23	2.35	−.96	19.27	1.01	106
Pittsburgh, WBO	4.94	1.86	2.72	−.77	4.75	.92	2.83	−.89	.29	−2.79	15.53	−1.67	90
Uniontown	3.31	−.42	2.45	−1.69	2.60	−2.25	3.17	−1.58	.80	−3.67	12.33	−9.61	56
Northwest Plateau	3.73		2.91		6.18		2.17		1.78		16.77		
Clarion	6.64	2.89	2.96	−1.25	4.79	.09	2.84	−1.73	2.70	−1.19	19.93	−1.19	94
Corry	5.89	2.10	2.11	−1.85	7.11	2.30	2.99	−.60	2.56	−.84	20.66	1.11	106
Kane	6.38	2.43	3.31	−1.41	4.98	.33	1.46	−2.95	1.75	−1.88	17.88	−3.48	84
NEW JERSEY													
Northern	5.81	2.03	2.71	−1.58	2.23	−1.93	1.80	−2.82	2.08	−2.99	14.63	−7.29	67
Flemington	5.55	1.90	1.00	−3.34	3.30	−.62	.97	−3.41	1.28	−4.05			
Newton	5.56	1.96	1.82	−2.42	1.96	−2.51	2.11	−2.57	1.30	−3.36			
Southern	4.01	.57	1.03	−2.96	2.14	−1.57	.97	−3.08	2.08	−3.12	10.23	−10.16	50
Hammonton	2.45	−1.22	.55	−3.60	4.39	.35	.71	−3.48	1.82	−4.13			
New Brunswick, Experiment Station	5.66	2.32	.96	−3.03	2.19	−1.64	1.31	−2.94	3.66	−1.12			
Coastal	3.78	.53	.78	−2.59	2.11	−1.06	1.03	−2.38	2.49	−2.42	10.19	−7.92	56
Atlantic City, WBO	2.28	−1.12	1.54	−2.44	2.76	−.23	.31	−3.47	3.38	−1.34			
Long Branch	5.64	2.10	1.00	−2.64	1.43	−2.16	.84	−3.25	2.82	−2.55			
NEW YORK													
Western Plateau	5.32	2.22	3.83	−.08	4.03	.37	3.15	−.60	1.32	−2.14	17.65	−.23	99
Angelica	4.65	2.05	3.74	.32			2.76	−.77	.83	−2.04			
Elmira	5.02	2.17	3.84	−.22	3.69	.26	3.16	−.34	1.22	−2.90			
Eastern Plateau	3.95	.69	3.81	−.07	3.12	−.56	3.81	−.39	2.18	−1.83	16.87	−2.16	89
Norwich	4.33	1.11	3.73	.03	4.97	1.23	4.30	.01	2.82	−.88			
Roxbury	3.12	−.48	5.21	1.12	2.83	−1.04	3.25	−.84	1.42	−2.73			
Northern Plateau	2.70	−.56	3.99	.43	5.16	1.66	4.19	−.02	1.02	−2.63	17.06	−1.12	94
Lowville	2.47	−.64	3.67	.55	4.46	1.78	3.88	.61	.80	−2.36			
Tupper Lake, Sunmount	2.11	−.55	3.42	.12	4.26	.96	3.36	−.68	2.04	−1.83			
Atlantic Coast	5.26	1.60	2.56	−1.23	1.53	−2.01	2.27	−1.28	3.53	−1.32	15.15	−4.24	78
Bridgehampton	3.93	.33	1.98	−1.55	.22	−2.74	1.57	−1.02	3.27	−1.38			
Scarsdale	5.03	1.01	2.55	−1.93	2.22	−1.74	3.90	−.58	3.15	−1.87			
Hudson Valley	3.47	−.08	3.28	−.73	2.55	−1.41	3.42	−.86	1.77	−2.28	14.49	−5.36	73
Albany WBAS	2.25	−.36	4.94	2.14	2.36	−1.01	2.17	−1.13	1.66	−1.23			
Poughkeepsie	4.99	1.42	2.15	−1.64	1.69	−2.00	2.02	−2.11	1.49	−2.52			
Mohawk Valley	3.06	−.53	3.64	−.08	3.86	−.12	5.31	.79	2.29	−1.62	18.16	−1.56	92
Gloversville	2.58	−1.07	3.57	−.25	2.90	−1.12	6.00	1.73	2.50	−1.34			
Little Falls, City Reservoir	2.41	−.97	3.97	.36	3.44	−.56	5.64	1.08	2.59				
Champlain Valley	1.48	−1.47	3.47	.34	4.03	.64	3.56	−.12	.95	−2.38	13.49	−2.99	82
Dannemora	1.44	−1.50	4.45	1.17	3.69	.17	4.22	.67	.39	−2.86			
Whitehall	1.65	−1.49	3.41	.16	2.92	−.63	2.19	−1.90	2.42	−1.00			
St. Lawrence Valley	2.32	−.65	3.86	.58	4.15	1.29	3.25	−.35	.29	−2.77	13.87	−1.90	88
Canton	2.26	−.74	3.79	1.57	3.27	.11	3.18	−.55	.23	−2.89			
Lawrenceville	2.25	−.53	4.43	1.07	3.23	.12	3.94	.34	.09	−3.26			
Great Lakes	3.67	.73	3.52	.41	4.10	1.36	2.86	−.05	1.10	−1.72	15.25	.73	105
Buffalo, WBAS	4.86	2.31	4.03	1.56	2.92	.22	2.97	.54	1.11	−1.43			
Oswego, Teachers College	2.06	−.68	3.45	.52	4.00	1.85	2.89	.22	1.42	−1.11			
Rochester WBAS	2.77	.13	2.98	.34	3.63	.78	2.24	−.85	.96	−1.52			
Central Lakes	3.56	.78	3.95	.81	3.70	.67	4.65	1.39	1.45	−1.54	17.31	2.11	114
Geneva, Experiment Station	3.99	1.25	3.80	.67	2.83	−.26	3.21	.20	.85	−1.97			
Syracuse, WBAS	2.60	−.52	2.88	−.02	4.18	.50	6.13	2.87	3.45	.36			
CONNECTICUT													
Northwest	4.38		2.47		1.86		2.83		2.66		14.20		
Cream Hill	3.46	−.17	2.27	−1.71	1.58	−2.64	3.24	−1.32	2.92	−1.45	13.47	−7.29	65
Central	4.52		2.15		1.29		2.36		3.08		13.40		
Storrs	4.10	.54	1.59	−1.91	.75	−2.42	2.31	−1.91	4.25	.09	13.00	−5.61	70
Coastal	4.70		2.83		.71		2.21		3.29		13.74		
New Haven WBAS	4.62	.73	2.75	−1.12	.96	−2.85	1.35	−2.31	2.95	−1.16	12.63	−6.71	65
MAINE													
Northern	2.16		2.09		3.11		4.32		2.13		13.81		
Caribou	2.57	−.06	1.62	−1.52	3.98	.03	6.83	2.80	.93	−2.60	15.93	−1.35	92
Jackman	2.37	−.56	3.08	−.28	2.76	−1.23	3.37	−.21	2.96	.10	14.54	−2.18	87
Southern Interior	2.37		2.95		3.26		3.83		1.40		13.81		
Farmington	2.06	−1.46	3.07	−.51	3.66	−.07	3.50	−.09	1.90	−1.81	14.19	−3.94	78
Woodland	3.62	−.17	2.86	.25	1.84	−1.32	4.00	1.54	3.00	−.12	15.32	.18	101

See footnote at end of table.

TABLE 2.—*Precipitation and its departure from normal*—Continued

	April 1957		May 1957		June 1957		July 1957		August 1957		5-month total		
	Precip.	Dept.	Precip.	Dept.	Precip.	Dept.	Precip.	Dept.	Precip.	Dept.	Precip.	Dept.	Percent[1]
MAINE—Continued													
Coastal	2.73		2.60		2.18		2.56		1.94		12.01		
Bar Harbor	3.88	.13	2.74	−.61	1.74	−1.53	2.57	−.79	2.67	−.58	13.60	−3.38	80
MASSACHUSETTS													
Western	2.98		4.10		3.11		3.88		2.37		16.44		
Pittsfield, WBAS	2.69	−.92	4.09	.33	2.91	−1.68	3.03	−1.92	3.02	−1.29	15.71	−5.48	74
Central	3.19		3.46		2.39		1.16		1.61		11.81		
Fitchburg	3.13	−.92	3.16	−.32	2.50	−1.09	.46	−3.31	1.29	−2.63	10.55	−8.27	56
Springfield, Armory	4.48	1.18	2.96	−.76	1.17	−2.61	3.51	−.76	1.10	−3.14	13.22	−6.09	68
Coastal	3.78		2.12		.72		1.81		3.34		11.77		
Brockton	4.39	.91	1.86	−1.08	.58	−2.45	.75	−2.88	2.15	−1.30	9.73	−6.80	59
Nantucket, WBAS	2.67	−.78	1.46	−1.45	.26	−2.98	2.84	.01	4.19	.76	11.42	−4.44	72
NEW HAMPSHIRE													
Northern	2.15		3.46		3.97		5.86		1.36		16.80		
Bethlehem	1.03	−1.60	3.73	.88	3.91	.25	5.36	1.32	.71	−2.78	14.74	−1.93	88
First Connecticut Lake	2.67	−.72	3.70	−.18	4.42	.05	7.60	2.75	2.50	−1.62	20.89	.28	101
Southern	1.94		3.08		3.09		1.25		1.53		13.41		
Keene	2.23	−.86	4.14	1.03	2.23	−1.00	2.32	−1.48	1.11	−2.75	12.03	−5.06	70
Lakeport	2.02	−1.38	3.32	.11	3.93	.60	3.44	−.45	1.34	−2.20	14.05	−3.32	81
RHODE ISLAND	4.32		1.72		.66		1.25		3.52		11.47		
Kingston	4.34	−.29	1.99	−1.87	.12	−3.34	1.46	−1.88	4.60	.30	12.51	−7.08	64
VERMONT													
Northeastern	1.88		3.17		4.64		4.83		1.23		15.75		
Chelsea	1.72	−1.07	3.51	.49	4.75	1.41	4.44	.98	1.23	−2.20	15.65	−.39	98
Newport	2.79	−.15	3.33	.26	4.07	.64	5.36	.97	1.62	−1.37	20.05	.35	102
Western	2.04		3.50		5.13		4.21		1.42		16.30		
Burlington WBAS	2.11	−.52	2.95	.06	7.35	3.78	5.34	1.59	.72	−2.29	18.47	2.62	117
Rutland	1.71	−1.40	3.45	.06	3.81	−.13	4.78	.85	2.92	−.68	16.67	−1.30	93
Southeastern	2.47		3.62		3.80		3.62		1.31		14.82		
Somerset	3.60	−1.07	4.63	.46	6.27	1.88	5.32	.76	1.53	−2.78	21.35	−.75	97

[1] Percent of 5-month long-term mean.

and cooperating observers from Virginia to Maine is shown in table 2. The monthly averages and departures for the various climatological divisions are based on all reports within the division. In the States of New England and in Pennsylvania and West Virginia, the monthly long-term means are not yet available for the climatological divisions shown. In those areas no division monthly departures can be computed.

A close inspection of table 2 will convince one that the worst of the moisture deficiency occurred in the coastal strip from inner Cape Cod to the Virginia Capes—in agreement with figure 2. In Virginia the Eastern Piedmont and Tidewater sections received, generally speaking, the least rainfall. Western Maryland was spared the worst of the drought, but the rest of the State and Delaware suffered. In New York the rainfall pattern was such that the southeastern part received the least, along with eastern Pennsylvania and nearly all of New Jersey where for the State as a whole, the May through July rainfall was the lowest on record (back to 1866). The southeastern half of New England also endured a severe shortage of rainfall.

An overall picture of the 5-month period is shown in figure 3 which presents the total 5-month average precipitation over each of the climatological divisions in terms of percentage of the 5-month long-term mean. This map is based on the totals in table 2. In those States where division long-term means are not yet available, the percentage for individual stations has been used and the isopleths in figure 3 were smoothed somewhat subjectively.

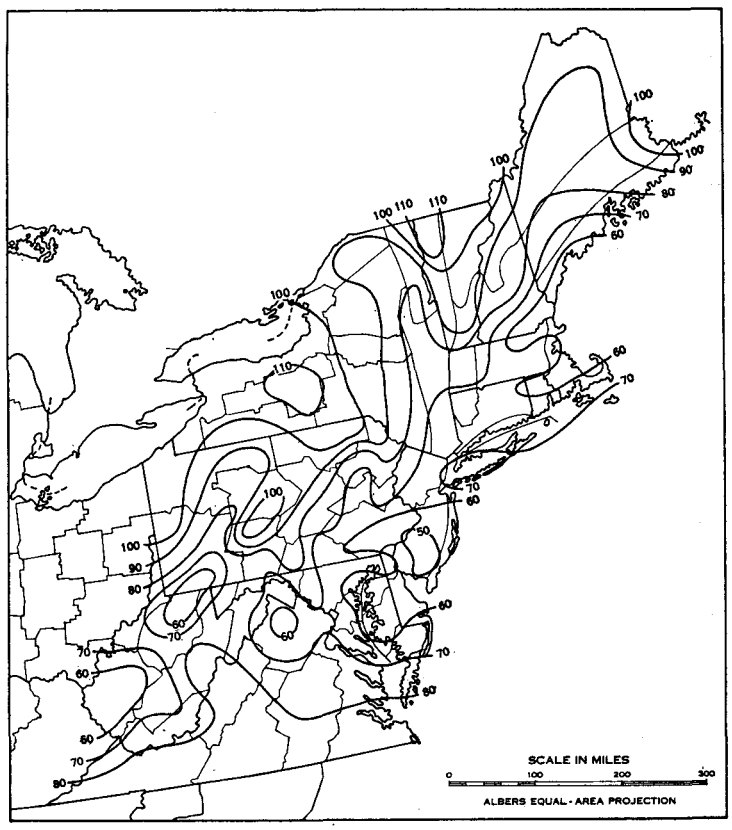

FIGURE 3.—Percentage of long-term mean precipitation, April–August 1957.

While this procedure is not entirely satisfactory, it seems the best that can be done under the circumstances.

The data shown in tables 1 and 2 and figures 1 and 3 represent the "high road" approach to drought, and it is apparent that though a picture of the drought situation can be gleaned from these data, it is not a picture that is very distinct and is not at all amenable to comparison with other droughts at other times and places.

4. STREAMFLOW AND GROUND WATER

Another way of looking at the drought is to examine its effect on streams, reservoirs, and well-levels. In April 1957, runoff and streamflow were deficient over most of New York and New England, except in their southern fringes. Ground-water levels reached record-low stages for the month at key wells in Maine, New Hampshire, and Vermont. Over the rest of the Northeast (including Virginia) the water situation was generally satisfactory.

In May, however, practically the entire Northeast, particularly New England, suffered from deficient streamflow. Runoff was subnormal in New England, southern New Jersey, and Maryland. "Ground-water levels generally declined and were below average except in western New York and northwestern Pennsylvania. Record-low levels for May were observed in wells in Maine, New Hampshire, Massachusetts, and Connecticut." [3] Deficient runoff, below-average reservoir storage, and very low ground-water levels also characterized the Northeast in June; many New England wells reached record-low levels for the month.

July brought some improvement, but the coastal area continued in poor condition. Streamflow was about median in Maine, but reservoir storage was considerably below average and ground-water levels mostly subnormal. Runoff ranged from excessive in northern Vermont to greatly deficient in southeastern Massachusetts and Rhode Island. Ground-water levels in Rhode Island, Massachusetts, and southern New Hampshire declined to below average; in some wells they were record-low for July. Connecticut streams were at or near record-low flows. Southeastern New York also remained in the drought area. Streamflow and well-levels in New Jersey continued to decline, especially in the southern half of the State. The other Northeastern States, except "upstate" New York and western Pennsylvania, also experienced deficient streamflow and low ground-water levels. In August, runoff was deficient over most of the Northeast, south of Maine. Ground-water levels remained below average and were at or near record-low stages in southern New England. In Connecticut, the key station on the Quinebaugh River at Jewett City set a new runoff low in its 40 years of record, 20 percent lower than in October 1930, the previous minimum month of record. The key station, Great Egg Harbor River, at Folsom, N. J., with 32 years of record, had record-low runoff for the second consecutive month. Though late-August rains [4] alleviated the agricultural drought in many sections, they had little effect on runoff or ground-water recharge.

Thus, the hydrologic aspects confirm the same general picture of summer drought, most intense and of record-breaking character along the southern New England and Middle Atlantic Coasts.

5. CROP CONDITIONS

The best measure of agricultural drought, if an adequate network of measuring stations were available, would be that furnished by regular, standardized measurements of soil moisture. In the absence of such data, it has been necessary to consider the subject by the previous indirect approaches. Since some soil moisture conditions are reported in the Northeast, it is possible to make some attempt to attack the situation directly.

In all the States involved, the Weather Bureau and the Agricultural Marketing Service of the U. S. Department of Agriculture (in some cases with the cooperation of other Federal or State agencies) join in issuing weekly weather and crop reports. Much of the information collected in these publications comes from county agents and actual growers, and from such sources as these, the development of the drought during the past summer can be reconstructed. This development is summarized, by States, in the following paragraphs; unless otherwise indicated the quoted remarks were taken from the weekly reports issued for the respective State.

New England.—In New England, after a mid-April to mid-May dry spell, the beginning of June found moisture supplies fairly adequate and crop development ranging from good to excellent, except in some very dry localities mostly in Rhode Island, southeastern Massachusetts, and eastern Connecticut. A month later, though the three northern States had benefited from rainfall, southern New England was gripped by drought. In mid-July it was reported that "severe dry weather continues to damage non-irrigated crops in eastern Massachusetts, eastern Connecticut, and Rhode Island." Widespread showers toward the end of July helped some sections but "much more rain is badly needed throughout most of the area." Conditions improved slowly during August, and on September 3 it was noted that in northern New England, potatoes, corn, and vegetables "had about completed growth under generally favorable conditions"; while in the southern part "The drought has been quite generally relieved and most crop prospects have improved markedly."

New York.—There was also an early-season drought general throughout New York State, but about May 10–13 it was broken upstate by bountiful rains, and this area was thereafter spared the worst. Downstate, however, dry weather continued and intensified; on June 24 it was reported that "dry soil conditions are becoming more serious in several southeastern counties and on Long Island." A month later (July 29) this observation was made: "Crops generally continued to make satisfactory to good growth except for the Hudson Valley area and Long Island where dry soil conditions have seriously affected

pastures and some crops." By August 19, "drought conditions continued to increase in the more eastern counties and moisture deficiency is beginning to show in some western counties." Some rainfall during the latter part of the month gave spotty relief, but as late as September 9 soils were still dry in many locations.

New Jersey.—During April, New Jersey had generally ample soil moisture, but this was greatly reduced over the next two months. It was reported on July 8 that the "soil moisture deficiency is becoming more serious" and that "near-drought conditions prevail in central and southern counties, and in some counties of northern New Jersey." These conditions deteriorated during July and August; a general rain on August 25–26 was "the first in the State since early April."

Pennsylvania.—Though the latter half of April in Pennsylvania was wet, May went to the other extreme, and as June began, soil moisture was generally below normal. This month brought rain, so that on July 1 it was noted that "soil moisture is generally adequate." During the next three weeks, however, rainfall was deficient, and on the 22d the report read: "In some sections of the Southeast most crops are beginning to show signs of drought conditions, particularly hay fields and pastures." This situation grew worse; by August 12, crops throughout most of Pennsylvania were in urgent need of rain, with drought prevailing in the majority of the southeastern counties. On September 9 it was still noted that "dry conditions prevail throughout most of the State and crops are in generally poor condition."

Maryland and Delaware.—Lack of soil moisture was in evidence in southern Maryland and the Eastern Shore as early as May 7. On the 13th, this was stated: "Three successive weeks of sparse rainfall in combination with above-average temperatures spread drought throughout Maryland and Delaware. At the end of this week soils were reported 'dry' to 'very dry', with the moisture situation in the southern portion of the two-State area considered to be more critical than elsewhere." On June 4 soil moisture was considered about "normal" by crop and weather reporters only in north-central and western Maryland and the extreme northern portion of the Eastern Shore. During June, July, and August (up to the 25th) soil moisture decreased as the drought entered its critical phase. Except for corn, most crops responded rather well to the late-August rains; but as late as September 10 more rain was still needed to revive pastures which on September 1 "were in poorest condition ever recorded in Delaware for that date and in Maryland . . . were the poorest of record except for 1930."

Virginia.—When the growing season opened in Virginia, there was adequate soil moisture, but this "was rapidly depleted April 16–May 15, during which time very little rainfall was recorded especially over the Piedmont and Tidewater portions of the State." [1] From mid-May through early June, above-normal rainfall returned soil moisture to satisfactory levels for most crops. Then came the worst period, mid-June through mid-August,

TABLE 3.—*Plant-available water in soil and deficit (inches),*[1] *Upper Marlboro, Md. Monmouth fine sandy loam. Fescue sod*

Date		Depth (inches)					Precipitation past week (inches)
		0–6	6–12	12–24	24–36	Total	
Apr. 10	Available	1.4	1.3	2.5			
	Deficit	.1	.3	.4			
18	Available	1.0	1.2	2.5			0.17
	Deficit	.5	.4	.4			
24	Available	.7	1.1	2.4			
	Deficit	.8	.5	.5			
May 1	Available	1.0	.7	2.0			[2].75
	Deficit	.5	.9	.9			
8	Available	.4	.7	1.6	1.9	4.6	
	Deficit	1.1	.9	1.3	.9	4.2	
15	Available	.3	.4	1.3	2.0	4.0	.30
	Deficit	1.2	1.2	1.6	.8	4.8	
22	Available	.5	.4	1.3	1.7	3.9	.74
	Deficit	1.0	1.2	1.6	1.1	4.9	
29	Available	.2	.4	1.3	1.6	3.5	
	Deficit	1.3	1.2	1.6	1.2	5.3	
June 6	Available	1.4	.8	1.0	1.5	4.7	2.22
	Deficit	.1	.8	1.9	1.3	4.1	
12	Available	.7	.8	1.3	1.1	3.9	.08
	Deficit	.8	.8	1.6	1.7	4.9	
19	Available	.5	.4	.9	1.0	2.8	1.29
	Deficit	1.0	1.2	2.0	1.8	6.0	
26	Available	.8	.4	.8	.7	2.7	1.07
	Deficit	.7	1.2	2.1	2.1	6.1	
July 3	Available	0	.3	.9	.6	1.8	.17
	Deficit	1.5	1.3	2.0	2.2	7.0	
10	Available	0	.2	.6	.5	1.3	.18
	Deficit	1.5	1.4	2.3	2.3	7.5	
17	Available	−.1	.2	.5	.5	1.1	
	Deficit	1.6	1.4	2.4	2.3	7.7	
24	Available	.4	0	.5	.5	1.4	.51
	Deficit	1.1	1.6	2.4	2.3	7.4	
31	Available	−.1	.1	.5	.6	1.1	.02
	Deficit	1.6	1.5	2.4	2.2	7.7	
Aug. 7	Available	−.1	0	.2	.4	.5	.13
	Deficit	1.6	1.6	2.7	2.4	8.3	
14	Available	−.1	.1	.5	.3	.8	.04
	Deficit	1.6	1.5	2.4	2.5	8.0	
21	Available	.1	0	.3	.5	.9	.30
	Deficit	1.4	1.6	2.6	2.3	7.9	
28	Available	.7	.6	.6	.3	2.2	1.95
	Deficit	.8	1.0	2.3	2.5	6.6	
Sept. 4	Available	.8	.6	.8	.4	2.6	1.00
	Deficit	.7	1.0	2.1	2.4	6.2	
11	Available	1.0	.7	.7	.5	2.9	1.18
	Deficit	.5	.9	2.2	2.3	5.9	
18	Available	1.2	1.2	1.7	.7	4.8	3.13
	Deficit	.3	.4	1.2	2.1	4.0	

[1] Available moisture based on 15-atmosphere wilting point determinations made in September 1957.
[2] Irrigation.

when "moisture demands by crops exceeded available supplies earliest in the Tidewater and Eastern Piedmont sections, spreading to the Northern and the Central Mountain areas during July and early August, while becoming more severe in the eastern half of the State." [1]

West Virginia.—Soil moisture in West Virginia was "generally adequate" in early June after an early-May dry spell. By the first week of July, soil moisture was "becoming in short supply over much of the State." It was reported "acutely short" on July 19, with "most of the State suffering from drought conditions." Rains during the week of the 22–26th helped the situation somewhat, but on August 9 soil moisture was "becoming critically short." On August 30 it was noted that "farm crops are suffering severely from lack of soil moisture and many farmers are forced into early feeding or sale of their livestock. Pastures are burned badly and are furnishing very little forage . . . Although dry conditions are predominant, there are a few scattered areas that have had a good growing season." The drought was still continuing through early September.

[1] Special communication from Kenneth A. Rice, State Climatologist.

TABLE 4.—*Soil moisture conditions in New Jersey, early August 1957*

Location	Crop	Soil type	Depletion Depth (inches)
NORTHERN NEW JERSEY			
Newton, Sussex County	Alfalfa	Dutchess loam	18
Sparta, Sussex County	Alfalfa-orchard grass.	Dover loam	18
Stockholm, Sussex County	Clover	Gloucester gravelly loam.	36
Hackettstown, Warren County	Soybeans—sorgo	Washington loam	18
Butler, Morris County	Woods	Gloucester gravelly loam.	36
Hibernia, Morris County	Corn	Merrimac sandy loam	30
Lake Hopatcong, Morris County	Woods	Rockaway loam	26
Gladstone, Somerset County	Orchard grass	Anandale loam	24
Martinsville, Somerset County	Vacant field (woods).	Montalto loam	9
Jamesburg, Middlesex County	Rhubarb	Spotswood loam	54
Plainsboro, Middlesex County	Woods	Spotswood loam	0
Marlboro, Monmouth County	Sweet corn	Freehold sandy loam	24
Hightstown, Mercer County	Abandoned orchard.	Spotswood sandy loam.	36
Pennington, Mercer County	Abandoned field (weeds).	Penn silt loam	30
Washington's Crossing, Mercer County.	Corn	Lansdale loam	0
SOUTHERN NEW JERSEY			
Beverly, Burlington County	Woods	Evesboro sand	60+
Mount Laurel, Burlington County.	Soybeans—sorgo	Collington sand	30
Pemberton, Burlington County	Alfalfa	Collington sandy loam.	42
Berlin, Camden County	Asparagus	Evesboro sandy loam	0
Haddonfield, Camden County	Alfalfa	Collington sandy loam.	36
Glassboro, Gloucester County	Apples	Keansburg sandy loam.	36
Swedesboro, Gloucester County	Corn	Sassafras sandy loam	18
Alloway, Salem County	Corn	Keyport loam	12
Palatine, Salem County	Corn	Aura loamy sand	42
Penns Grove, Salem County	Asparagus	Sassafras loamy sand	0
Bridgeton, Cumberland County	Corn	Downer loamy sand	36
Leesburg, Cumberland County	Tomato	Sassafras loamy sand	0
Woodbine, Cape May County	Woods	Sassafras sand	42

6. SOIL MOISTURE

At a number of locations in the drought area, measurements of soil moisture were taken and afford invaluable information both for their own sake as well as for the light they shed on the other drought indicators. The Tobacco Experiment Farm of the College of Agriculture, University of Maryland, situated at Upper Marlboro, Md. (about 15 miles southeast of downtown Washington, D. C.) was in one of the worst-affected areas. On May 8 (see table 3) the top 6 inches of soil was found by gravimetric sampling to be near the wilting point. This continued through the month and on May 29 there was only 0.6 inch of available water in the top 12 inches. During July and early August there were very low or "negative moisture" values, indicating the soil to have been dried to near or below the permanent wilting point at all levels down to the lowest measured (3 feet). This condition persisted into early September, with some improvement in the upper layers toward the end of the period.

The data from a series of gravimetric soil moisture measurements [2] made in New Jersey under representative crops are presented in table 4, according to the "depletion depth." By this is meant the soil depth to which the soil moisture was found to be depleted to the permanent wilting point or below. The 60+ figure results from the fact that no samples were taken below a depth of 60 inches. The zero values indicate that some moisture existed at all levels sampled, even though soil moisture may have been very close to the wilting point. Of course, samples could only be made down to shallower depths than 60 inches in those cases where the underlying parent material was reached first. In general, the soils are much shallower in northern than in southern New Jersey. Consequently, it cannot be concluded from the fact that the greatest depletion depths are shown in southern locations that the drought was not as severe or even more severe in the north. For example, at Newton, solid rock was reached at only 18 inches, which had to be reported as the depletion depth; but from the point of view of growing crops the conditions at these sites may have been more severe than, say, the 24-inch depletion depth at Marlboro, N. J.

In Rhode Island a series of soil moisture measurements have been taken at Kingston [3] during the summer and are summarized in table 5. These data indicate a very serious shortage of soil moisture developed late in June,

TABLE 5.—*Percent of available moisture, Kingston, R. I. Narragansett loam. Pasture plot*

Date	Depth (inches)			
	4	8	12	24
	(Percent)	(Percent)	(Percent)	(Percent)
June 7	36	38	47	78
14	28	29	37	76
28	13	11	11	34
July 5	4	1	0	13
12	3	0	0	9
19	0	0	0	8
26	35	0	0	9
Aug. 1	29	0	1	13
8	56	52	0	16
19	53	63	43	28
26	78	81	49	58
Sept. 6	25	45	49	72

TABLE 6.—*Plant-available water in soil and deficit (inches), Windsor Conn. Merrimac sandy loam. Shade tobacco*

Date		Depth (inches)	
		0-6	6-11
June 21	Available	0.76	
	Deficit	0.21	
28	Available	0.87	
	Deficit	0.10	
July 5	Available	0.82	
	Deficit	0.15	
12	Available	0.75	0.92
	Deficit	0.22	[1]—0.10
19	Available	0.50	0.66
	Deficit	0.47	0.16
25	Available	0.59	0.68
	Deficit	0.38	0.14
Aug. 2	Available	0.82	0.97
	Deficit	0.15	[1]—0.15
8	Available	0.49	0.71
	Deficit	0.48	0.11
15	Available	0.47	0.59
	Deficit	0.50	0.23
23	Available	0.44	0.50
	Deficit	0.53	0.32

[1] Negative deficit indicates amount above field capacity.

[2] The New Jersey measurements were made by Dr. N. A. Willits, Associate Professor of Soils, New Jersey Agricultural Experiment Station, Rutgers University; his courtesy in making them available for this article is appreciated.

[3] The Rhode Island soil moisture measurements are furnished through the courtesy of Dr. R. C. Wakefield, Associate Professor, Agronomy Department, Rhode Island Agricultural Experiment Station.

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reached its maximum in mid-July, and remained quite serious until about mid-August. However, the Connecticut data [4] in table 6 do not indicate as intense or as prolonged moisture shortages under the "shade tobacco" conditions as under the pasture conditions at Kingston.

In both States crops deteriorated rapidly after mid-June and did not show any recovery until rainfall in late July brought some relief to portions of southwestern Connecticut. The eastern counties of Connecticut and Rhode Island continued very dry, and wells, streams, and ponds, never in memory dry before, dried up. Farmers were forced to haul water for livestock and other uses and barn feeding of livestock was necessary as pastures for the most part failed to provide any significant grazing. The first general rain in 3 months occurred on August 25–26 to put soil in the most favorable moisture condition since May.

7. CONCLUSION

The above material may be summarized as follows:

A. The Eastern drought primarily affected the coastal strip from southeastern Massachusetts, Rhode Island, and Connecticut, through southern New York, New Jersey, and eastern Pennsylvania, to Delaware, Maryland, and eastern Virginia. In general, conditions were less severe in the interior, though West Virginia and some other inland areas appear to have been hurt badly.

B. The drought began in mid-April; April 10 is frequently cited in the reports as the beginning of the dry spell. This was not too harmful agriculturally, because of the early stage of most crops, and because it was alleviated in several areas by late-May rains. The important months of June and July, however, defined the worst drought area (as just described), and most of August intensified it. Good rains came to many areas in late-August and early-September (especially noteworthy being the August 25–26 coastal storm [4]), but many localities continued to suffer from deficient moisture throughout.

C. The period of mid-June to mid-August may be taken, from both the climatological and the agricultural viewpoints, as the worst phase of the drought. The map of moisture deficiency represents conditions during this period fairly well, except in West Virginia. The evidence of the map is well supported by the rainfall figures and the streamflow and ground-water data. The reports of crop conditions, in general, bear out very well the conclusions regarding the duration and areal extent of the drought. If more soil moisture measurements were available, in addition to those cited, it would be possible to speak with more certainty regarding these points.

D. From the climatological and hydrologic standpoints, the drought was rather severe. The fact that so many Weather Bureau stations reported new record-low rainfall during the period, plus the near-record or record-breaking character of much of the streamflow data, indicate that, for the region affected and the time of year, it may be considered as unprecedented in some areas. Two qualifications must be quickly added to this blanket statement. The drought did not affect all parts of the Northeast equally, and some places may have been troubled by it scarcely at all. On the other hand, even in the badly-hit areas, some localities may have been more grievously affected in the past. The second qualification is this: no precise evaluation of the drought in strictly agricultural terms is here attempted.

E. The severity of drought depends on both the magnitude of the moisture deficiency and its duration. This drought in the East during the spring and summer of 1957 was without doubt very intense during these few months but its severity is hardly comparable with many other droughts which have affected other areas of the United States in the past—droughts in which the duration was measured in years rather than months [5].

[4] The Connecticut soil moisture data are furnished through the courtesy of Dr. H. C. De Roo, Associate Soil Scientist, Windsor Tobacco Laboratory, Connecticut Agricultural Experiment Station.

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